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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,805	02/04/2004	Michael R. Keenan	7213/99838	5230

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EXAMINER	
ABDELNOUR, AHMED F	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/772,805	KEENAN, MICHAEL R.
	Examiner	**Art Unit**
	Farras Abdelnour	2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date February 4, 2004.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: At specification page 2, line 6, and page 36, line 21, the meaning of "SD7276" is unclear. It appears from the context of the sentence that this is a docket number. If so, the corresponding U.S. patent application serial number should be added in its place.

2. Equation $\mathbf{C} = \mathbf{\check{C}G^{-1}}$ (page 15, line 23) is inconsistent with the definition of the weighted concentration matrix $\mathbf{\check{C}}$ (page 15, line 19), given by $\mathbf{\check{C}} = \mathbf{GC}$. Given the definition of matrix $\mathbf{\check{C}}$, the unweighted concentration matrix **C** should be $\mathbf{C} = \mathbf{G^{-1}\check{C}}$ (assuming the inverse of matrix **G** exists). Matrix multiplication in general does not commute.

Appropriate correction to above objections is required.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The USPTO "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility" (Official Gazette notice of 22 November 2005), Section IV.C, reads as follows:

> While abstract ideas, natural phenomena, and laws of nature are not eligible for patenting, methods and products employing abstract ideas, natural phenomena, and laws of nature to perform a real-world function may well be. In evaluating whether a claim meets the requirements of section 101, the claim must be considered as a whole to determine whether it is for a particular application of an abstract

> idea, natural phenomenon, or law of nature, rather than for the abstract idea, natural phenomenon, or law of nature itself.
>
> For claims including such excluded subject matter to be eligible, the claim must be for a practical application of the abstract idea, law of nature, or natural phenomenon. Diehr, 450 U.S. at 187, 209 USPQ at 8 ("application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection."); Benson, 409 U.S. at 71, 175 USPQ at 676 (rejecting formula claim because it "has no substantial practical application").
>
> To satisfy section 101 requirements, the claim must be for a practical application of the Sec. 101 judicial exception, which can be identified in various ways:
>
> > The claimed invention "transforms" an article or physical object to a different state or thing.
> >
> > The claimed invention otherwise produces a useful, concrete and tangible result, based on the factors discussed below.

Claims 1-20 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claim 1 recites the mere manipulation of data or an abstract idea, or merely solves a mathematical problem without a limitation to a practical application. A practical application exists if the *result* of the claimed invention is "useful, concrete and tangible" (with the emphasis on "result")(Guidelines, section IV.C.2.b). A "useful" result is one that satisfies the utility requirement of section 101, a "concrete" result is one that is "repeatable" or "predictable", and a "tangible" result is one that is "real", or "real-world", as opposed to "abstract" (Guidelines, section IV.C.2.b)). Claim 10 merely manipulates data without ever producing a useful, concrete and tangible result. Nowhere in the claims is the purpose of matrix factorization clearly explained. The claims as they stand amount to a description of purely mathematical manipulation of data, without offering clearly useful and concrete results. Remaining claims 2-9 and 11-20 depend on claims 1 and 10, respectively.

In order to for the claimed product to produce a "useful, concrete and tangible" result, recitation of one or more of the following elements is suggested:

- The manipulation of data that represents a physical object or activity transformed from outside the computer.
- A physical transformations outside the computer, for example in the form of pre or post computer processing activity.
- A direct recitation of a practical application;

Applicant is also advised to provide a written explanation of how and why the claimed invention (either as currently recited or as amended) produces a useful, concrete and tangible result.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 6, 7, 9, 10, 15, 16, 18, 19, and 20 rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of J.J. Andrew and T.M. Hancewicz ("Rapid analysis of Raman image data using two-way multivariate curve resolution," Applied Spectroscopy, Vol. 52, Number 6, 1998), and Parker *et al.* US 20020146160 A1

("Method and apparatus for generating two-dimensional images of cervical tissue from three-dimensional hyperspectral cubes,").

Regarding Claim 1, Andrew discloses steps of providing a data matrix **D** containing measured spectral data ("data matrix of spectra, **D**," page 798, column 2), and performing an image analysis on a data matrix $\check{\mathbf{D}}$ to obtain a transformed concentration matrix $\check{\mathbf{C}}$ and a spectral shapes matrix **S** (Equation (1), page 798), and computing a concentration matrix **C** from the transformed concentration matrix $\check{\mathbf{C}}$ (Consult equation (4), page 799). Andrew does not teach applying a wavelet transform to a data matrix **D**.

Parker teaches transforming the data matrix **D**, using a wavelet transform, to obtain a transformed data matrix $\check{\mathbf{D}}$ ("input processor 210 performs the compression phase of the E/C paradigm using Principal Component Analysis (PCA) based on the Singular Value Decomposition (SVD) of the wavelet data matrix," page 3, paragraph [0037]).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform a wavelet transform to a data matrix as taught in Parker for the purpose of capturing global and local features of an image (matrix) as well as reducing the dimensionality of a data space by decorrelating it.

Regarding Claim 6, the Andrew-Parker combination teaches the steps outlined in claim 1. Andrew further teaches obtaining factored matrices via constrained least square solution of a minimization problem ("The usual way this second step is achieved

is by using an iterative constrained least-squares method referred to as alternating least-squares," page 798, column 2).

Regarding Claim 7, the Andrew-Parker combination teaches the steps outlined in claims 1 and 6. Andrew further teaches alternating least squares analysis comprises a transformed non-negativity constraint ("Raman intensity values, which are related to component concentration, must also always be greater than or equal to zero. These non-negative constraints are imposed on the data structure during the least-squares optimization process," page 800, column 1)

Regarding Claim 9, the Andrew-Parker combination teaches the steps outlined in claim 1. Andrew further teaches obtaining factored matrices via constrained least square solution of a minimization problem ("The usual way this second step is achieved is by using an iterative constrained least-squares method referred to as alternating least-squares," page 798, column 2).

Regarding Claim 10, Andrew discloses steps of factoring a data matrix **D** ("data matrix of spectra, **D**," page 798, column 2) into data factors **A** and **B** (Equation (1), page 798), and performing an image analysis on a data matrix **Ã** and data factor matrix **B** to obtain a transformed concentration matrix **Č** and a spectral shapes matrix **S** (Equation (1), page 798), and computing a concentration matrix **C** from the transformed

concentration matrix $\check{\mathbf{C}}$ (Consult equation (4), page 799). Andrew does not teach applying a wavelet transform to a data matrix **A**.

Parker teaches transforming the data matrix **A**, using a wavelet transform, to obtain a transformed data matrix $\tilde{\mathbf{A}}$ ("input processor 210 performs the compression phase of the E/C paradigm using Principal Component Analysis (PCA) based on the Singular Value Decomposition (SVD) of the wavelet data matrix," page 3, paragraph [0037]).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to perform a wavelet transform to a data matrix as taught in Parker for the purpose of capturing global and local features of an image (matrix) as well as reducing the dimensionality of a data space by decorrelating it.

Regarding Claim 15, the Andrew-Parker combination teaches the steps outlined in claim 10. Andrew further teaches obtaining factored matrices via constrained least square solution of a minimization problem ("The usual way this second step is achieved is by using an iterative constrained least-squares method referred to as alternating least-squares," page 798, column 2).

Regarding Claim 16, the Andrew-Parker combination teaches the steps outlined in claims 10 and 15. Andrew further teaches alternating least squares analysis comprises a transformed non-negativity constraint ("Raman intensity values, which are related to component concentration, must also always be greater than or equal to zero.

These non-negative constraints are imposed on the data structure during the least-squares optimization process," page 800, column 1)

Regarding Claim 18, the Andrew-Parker combination teaches the steps outlined in claims 10. Andrew further teaches alternating least squares analysis comprises a transformed non-negativity constraint ("Raman intensity values, which are related to component concentration, must also always be greater than or equal to zero. These non-negative constraints are imposed on the data structure during the least-squares optimization process," page 800, column 1)

Regarding Claim 19, Andrew teaches obtaining matrices **T** and **P** (loadings matrix and scores matrix) from a data matrix **D** using principal components analysis ("There are many different ways to generate the pure **S** and **C** matrices, and they have been thoroughly reviewed.[6,12] Currently the most popular methods can be divided into two categories: principal factor methods, which use matrix decomposition as an initial step to generate abstract factors and scores," page 798, column 2).

Regarding Claim 20, Andrew teaches matrices T and P being significant components of the principal components ("For, *nc*, significant factors, **C** is an $m \times nc$ matrix related to the real concentration profiles, and S is an $n \times nc$ matrix related to the real spectra," page 798, column 2).

6. Claims 2 and 11 rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Andrew-Parker and Keenan *et al.* ("Algorithms for constrained linear unmixing with application to the hyperspectral analysis of fluorophore mixtures," M.R. Keenan, J.A. Timlin, M.H. Van Benthem, and D.M. Haaland, Proc. SPIE 4816, 193-202 (2002)).

Regarding Claim 2, Andrew-Parker discloses analyzing a multivariate image **D** as outlined in claim 1. Andrew-Parker does not disclose dividing an image into blocks of data $\mathbf{D}_j$, from which the concentration block $\mathbf{C}_j$ is evaluated following steps a)-d) of claim 1, then accumulating the blocks $\mathbf{C}_j$ into a matrix $\mathbf{C} = [\mathbf{C}_1\ \ \mathbf{C}_2 \ldots\ \ \mathbf{C}_{j-1}\ \ \mathbf{C}_j]$.
Keenan teaches constructing a matrix **D** from submatrices $\mathbf{D}_{ij}$ obtained from multiplying and summing concentration component matrices and pure spectrum component matrices (Equation (1), page 194). Claim 2 is a special case where the random noise matrix $\mathbf{E}_{ij}$ is zero.
It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide a matrix into data blocks as taught in Keenan so as to accelerate multiplication operation and reduce the required amount of memory in order to perform the multiplication.

Regarding Claim 11, Andrew-Parker discloses factoring a multivariate image **D** yielding data factors **A** and **B**, as outlined in claim 10. Andrew-Parker does not disclose dividing **A** into blocks of data $\mathbf{A}_i$, and dividing **B** into blocks of data $\mathbf{B}_i$ from which the

concentration block $\mathbf{C_j}$ is evaluated following steps a)-d) of claim 1, then accumulating the blocks $\mathbf{C_i}$ into a matrix $\mathbf{C} = [\mathbf{C_1}\ \ \mathbf{C_2} \ldots\ \ \mathbf{C_{j-1}}\ \ \mathbf{C_j}]$.

Keenan teaches constructing a matrix **D** from submatrices $\mathbf{D_{ij}}$ obtained from multiplying and summing data blocks (Equation (1), page 194). Claim 11 is a special case where the random noise matrix $\mathbf{E_{ij}}$ is zero.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to divide a matrix into data blocks as taught in Keenan so as to accelerate multiplication operation and reduce the required amount of memory in order to perform the multiplication.

7. Claims 3-5, 8, 12-14, and 17 rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Andrew-Parker and Vogt *et al.* (F. Vogt and M. Tacke, Fast principal component analysis of large data sets, Chemometrics and Intelligent Laboratory Systems, Volume 59, Issues 1-2, 28 November 2001, Pages 1-18).

Regarding Claims 3 and 12, Andrew-Parker discloses using a wavelet transform for analyzing the data matrix. Andrew-Parker does not explicitly disclose using Haar wavelet.

Vogt teaches using Haar wavelet transform for the purpose of analyzing spectral features ("For instance, all spectral features must be contained in the wavelet transformed spectrum. Use of Haar- or Daubechies wavelets involving periodic

boundary conditions make sure, that a perfect reconstruction of the origin," page 3, column 1).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to use Haar wavelet as taught in Vogt for the purpose of analyzing and compressing spectral features due to Haar wavelet's orthogonality and the simple implementation of a well established type of wavelet transforms.

Regarding Claims 4 and 13, Andrew-Parker discloses using a wavelet transform for analyzing the data matrix. Andrew-Parker does not explicitly disclose applying a threshold to the transformed data matrix.

Vogt teaches applying a threshold to the wavelet coefficients ("These wavelet coefficients in M are analyzed for their relevance, i.e. whether they represent spectral features, or whether they are irrelevant. For this discrimination, a threshold is needed whose determination is discussed in Section 2.2," page 2, column 2).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to threshold the transformed data as taught in Vogt for the purpose of reducing data redundancy (and thus amount of computation), and as a common application of wavelet transforms.

Regarding Claims 5 and 14, Andrew-Parker-Vogt discloses applying a threshold to wavelet-transformed data matrices. Andrew-Parker-Vogt does not explicitly disclose decimating detail coefficients.

However, it is implicit in (discrete) wavelet transform operation to downsample (decimate) the data as a necessary part of the scaling operation, the latter being a property of wavelets, as can be consulted in any wavelet textbook.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to decimate the detail coefficients as part of wavelet transform implementation.

Regarding Claims 8 and 17, Andrew-Parker discloses using a wavelet transform for analyzing a data matrix. Andrew-Parker does not explicitly disclose applying the inverse wavelet transform to a concentration (data) matrix.

Vogt teaches applying inverse wavelet transform to principal components ("In Appendix A, the effort for wavelet transforming the calibration spectra and inverse wavelet transforming the relevant PCs is discussed in detail," page 4, column 1).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to apply inverse wavelet transform taught in Vogt in order to recover a transformed matrix or a factor thereof.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Farras Abdelnour whose telephone number is 571-270-1806. The examiner can normally be reached on Mon. - Thurs. 7:30 - 17:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian P. Werner can be reached on 571-272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Examiner
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